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Microscopic investigation of nanoscale coesite crystals in ultra-high pressure silica glass from impactites

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Substances forming under ultrahigh pressures and high temperatures (UHPHT) raise an interest for understanding of some fundamental problems of matter state under extremely high PT conditions with a potential to new functional materials. In diamond-bearing impactites of the 70 Ma old Kara astrobleme (Polar Ural, Russia) HP post-impact liquation glasses with coesite have been discovered [1, 2], which may be interesting for understanding of general regularities in the formation and stability of crystalline-noncrystalline systems under extreme conditions. Microscopic methods, including AFM belong to the most effective methods for studying of nanoscale structure features of glass solids [3, 4].

For this work we collected vein-like UHPHT glasses from natural outcrops at banks of the river Kara. The chemical composition, phase state and local microstructure were determined by the methods of EDS, SEM and Raman spectroscopy. Nanoscale topography was detected by AFM and SEM. The surface morphology has been characterized by AFM measurements in tapping and phase contrast mode using an Integra Prima (NT-MDT, Russia) with super sharp silicon cantilevers of SSS-NCH (Nanosensors). The surfaces of the polished specimens were studied with a SEM Tescan MIRA3.

UHPHT glasses have fluidal microstructure and are composed of an amorphous matter with feldspar composition with small droplets of coesite-containing silica glass. Using the methods of microscopy, generally AFM, we have shown that the aluminosilicate glass matrix has a homogeneous nanostructure with rounded densely packed clusters of about 50-60 nm in size Coesite crystals are clearly distinguished within amorphous matrix of silica droplets, both on SEM images and by the phase-contrast AFM method. Their sizes vary from 50 nm to several micrometers. The silica matrix in droplets has a homogeneous nanostructure consisting of elongated clusters with sizes of 15-30 nm. In this way, microscopic images of UHPHT impactites demonstrate a result of initial impact melt differentiation to bisilicate phase and aluminosilicate by liquation and crystallization processes with the following solidification sequence at the melt cooling: (1) coesite; (2) silicate glass; (3) aluminosilicate glass.

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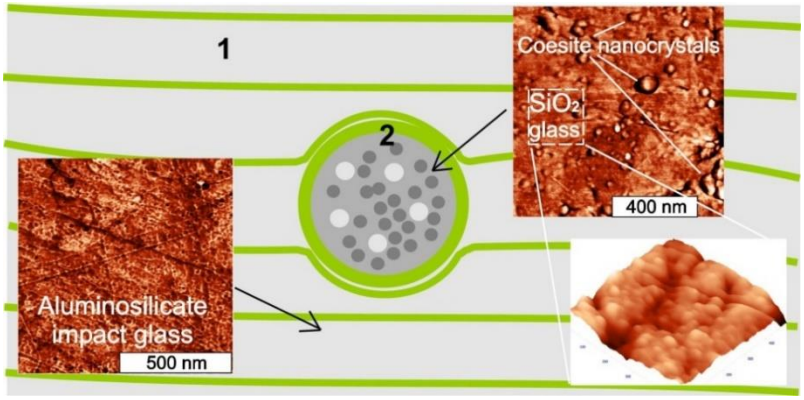

Figure 1. Schematic representation of the UHPHT impact glass microstructure: (1) aluminosilicate glass matrix; (2) a drop of coesite-containing silica glass within surrounding aluminosilicate glass matter.

1. T.G. Shumilova, V.P. Lutoev, S.I. Isaenko, et al, *Sci. Rep.* **8,** 6923 (2018).
2. T.G. Shumilova, S.I. Isaenko, B.A. Makeev, et al, *Doklady Earth Sciences* **480**, 595 (2018).
3. Ye.A. Golubev, T.G. Shumilova, S.I. Isaenko, et al, *J. Non-Crystalline Solids*. **500**, 388 (2018).
4. Ye.A. Golubev, T.G. Shumilova, S.I. Isaenko, *IOP Conf. Series: Mat. Sci. Eng*. **443**, 012008 (2018).